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City of Manchester.

RIVERS DEPARTMENT.

REPORT

FOR THE

TWO YEARS ENDED 31st MARCH, 1942.

RIVERS COMMITTEE.

1940–41.	1941–42.
Chairman : Alderman James C. Kidd.	*Chairman :* Councillor Robert C. Rodgers.
Deputy Chairman :	*Deputy Chairman :*
Councillor Robert C. Rodgers.	Alderman Robert W. Shepherd.
Members :	*Members :*
Alderman Robert G. Edwards, J.P. (Lord Mayor).	Alderman Wright Robinson, J.P. (Lord Mayor).
,, Robert W. Shepherd.	,, James C. Kidd.
,, G. Harold White, J.P.	,, G. Harold White, J.P.
Councillor Colonel S. P. Dawson, O.B.E., M.M., T.D., J.P.	Councillor Colonel S. P. Dawson, O.B.E., M.M., T.D., J.P.
,, Albert R. Edwards.	,, Albert R. Edwards.
,, Arthur Ellison.	,, Eugene Elliott.
,, John Ferguson.	,, John Ferguson.
,, John J. Flynn.	,, John J. Flynn.
,, Harry Frankland.	,, Harry Frankland.
,, Michael F. Griffin.*	,, Michael F. Griffin.*
,, Stanley H. Hitchbun.	,, Stanley H. Hitchbun.
,, Charles F. Howarth, J.P.	,, Charles F. Howarth, J.P.
,, Charles V. Jarvis.	,, Charles V. Jarvis.
,, James McGrath.	,, James McGrath.
,, Richard Turley.	,, Richard Turley.
,, William Winstanley, J.P.	,, William Winstanley, J.P.

* Substitute Member : Councillor Tom Nally.

General Manager of the Rivers Department :

James M. Wishart, B.Sc., F.I.C., A.M.I.Chem.E.

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CITY OF MANCHESTER.

Rivers Department.

Report for the Two Years Ended 31st March, 1942.

The Rivers Committee submit to the Council the following report on the work of the Rivers Department :—

Introduction.

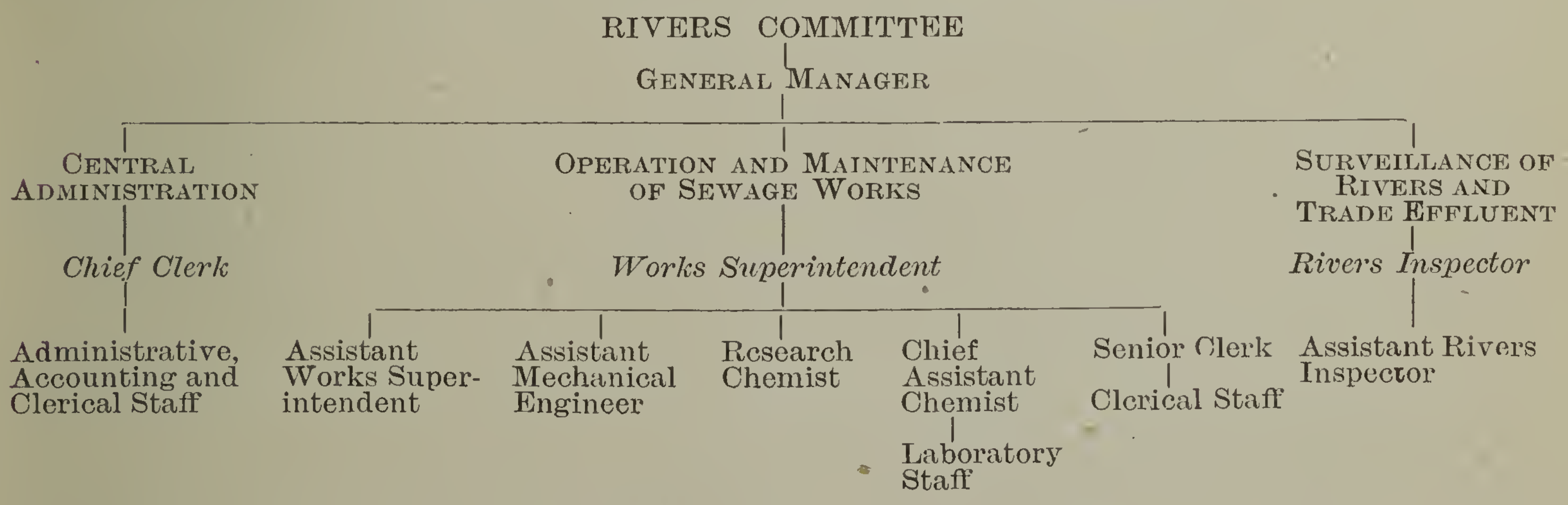
Owing to the reorganisation of the Rivers Department, and also to other circumstances connected with the war, the preparation of the Annual Report for the year ended 31st March, 1941, was delayed, and the Rivers Committee feel that it will be convenient as well as economical to present a Report covering the two years ended 31st March, 1942. This course has the additional advantage that a complete account can be given of the reorganisation of the Department which has been carried out during this period.

Reorganisation of the Department.

Prior to June, 1940, the Rivers Department consisted of three inter-connected sections, the heads of which had definite duties and separate responsibilities to the Rivers Committee. The heads of the three sections were (*a*) Secretary, (*b*) Consulting Chemist, and (*c*) Sewage Works Manager. The Secretary was responsible for central administration, the Consulting Chemist was responsible for the operation of the sewage works, for research and development, and also for the surveillance of rivers and streams, and of trade effluents discharged to the sewer. The Sewage Works Manager was responsible for the maintenance of the sewage works and the control of workmen.

In 1940, the Committee decided, in view of the impending retirement of the Secretary in June, 1940, the Consulting Chemist in September, 1940, and the Sewage Works Manager in January, 1942, to appoint a General Manager to take charge of the whole of the work of the Department which, until then, had been controlled by the three officers referred to. The present General Manager, Mr. J. M. Wishart, was appointed and he commenced duty on 1st January, 1941. During the period July to December, 1940, Mr. C. H. Ball, the Sewage Works Manager was Acting General Manager of the Department. On the retirement of the Sewage Works Manager in January, 1942, the reorganisation of the Department was completed. Mr. C. Jepson, formerly Resident Chemist, was appointed Works Superintendent to be responsible to the General Manager for the operation and maintenance of all the sewage works of the Department. A Mechanical Engineer was appointed to assist the Works Superintendent in the maintenance of the mechanical plant. The Senior Assistant Chemist was promoted to Chief Assistant Chemist and undertook the supervision of the work in the general laboratory. The general organisation of the Department is shown below :—

ORGANISATION OF THE RIVERS DEPARTMENT.


RIVERS COMMITTEE
General Manager
Central Administration
Operation and Maintenance of Sewage Works
Surveillance of Rivers and Trade Effluent
Chief Clerk
Works Superintendent
Rivers Inspector
Administrative, Accounting and Clerical Staff
Assistant Works Superintendent
Assistant Mechanical Engineer
Research Chemist
Chief Assistant Chemist
Laboratory Staff
Senior Clerk
Clerical Staff
Assistant Rivers Inspector

Reorganisation of Sub-Committees.

In view of the reorganisation of the Department outlined on previous page, it appeared necessary to reorganise the Standing Sub-Committees of the Rivers Committee. The names and functions of the former Standing Sub-Committees were as follows :—

NAME	FUNCTION
1. Audit Sub-Committee	To audit accounts.
2. Sickness and Accidents Sub-Committee	To receive and consider reports on cases of sickness and accident of workpeople.
3. Trade Refuse and Purifying Works Sub-Committee	To receive and consider reports relating to trade effluents discharged to the sewer and reports on the treatment of sewage at all the Sewage Works of the Department.
4. Davyhulme Works Sub-Committee	To receive and consider reports on the maintenance of Davyhulme Sewage Works.
5. Withington and Minor Works Sub-Committee	To receive and consider reports on the maintenance of Withington Works and minor works.

Each of these Sub-Committees, with the exception of the Sickness and Accidents Sub-Committee, consisted of the whole of the members of the Rivers Committee.

In order to simplify procedure it was decided to appoint two main Sub-Committees, one of which would deal with everything connected with the treatment and disposal of sewage and the other with all matters connected with the discharge of trade effluents to the sewer, and also with the conservancy of rivers and streams within the City. The names and functions of the present Standing Sub-Committees are as follows :—

NAME	FUNCTION
1. Works Sub-Committee	To consider all matters appertaining to the operation and maintenance of all the Sewage Works of the Department.
2. Trade Effluent and Rivers Surveillance Sub-Committee	To consider all matters appertaining to the discharge of trade effluent to the sewer, and also all matters appertaining to conservancy of rivers and streams.
3. Personnel Sub-Committee ..	To consider all matters affecting the staff and workmen employed in the Department, including salaries and wages, new appointments, sickness and accidents, and general welfare.

The Works Sub-Committee and the Trade Effluent and Rivers Surveillance Sub-Committee each consist of the Chairman and Deputy Chairman and not more than nine other members of the Rivers Committee. The Personnel Sub-Committee consists of the whole of the members of the Rivers Committee. The Audit Sub-Committee was not reappointed and accounts are now audited at the beginning of the Rivers Committee meeting.

Representation on Other Bodies.

The Council have appointed representatives on various Boards and Joint Committees, whose work is related to that of the Rivers Committee : the members of the Council being also members of the Rivers Committee serving on these bodies are indicated below :—

Rivers Mersey and Irwell Catchment Board ..	Alderman G. H. White (Chairman of the Board). Councillors S. P. Dawson and C. F. Howarth.
Lancashire Rivers Board	Alderman R. W. Shepherd (Chairman of the South Regional Committee). Alderman G. H. White. Councillors S. P. Dawson, S. H. Hitchbun, C. F. Howarth, and R. C. Rodgers.
Manchester Ship Canal Company	Aldermen R. W. Shepherd and G. H. White. Councillor S. P. Dawson.
Upper Mersey Navigation Commission	Alderman G. H. White.
Manchester and District Regional Planning Committee	Councillors J. Ferguson and T. Nally.

Retirement of Officials.

Mr. W. Porthouse retired from the position of Secretary to the Committee in June, 1940, after 41 years' service with the Corporation. He had held the position of Secretary for nine years and, before that, he had been Chief Clerk for 19 years.

Dr. E. Ardern retired from the position of Consulting Chemist to the Committee in September, 1940, after 41 years' service with the Corporation. He was appointed Resident Chemist at Davyhulme Works in 1904, Chief Chemist to the Committee in 1916, and Consulting Chemist in 1919. Dr. Ardern is well known for his distinguished work in the development of the activated sludge process of sewage purification. This process, which was initiated and developed on a practical scale at the Committee's sewage works, has been adopted by many authorities in this country and abroad.

Mr. C. H. Ball retired from the position of Sewage Works Manager in January, 1942. He was appointed Manager of Withington Works in 1905, Manager of Davyhulme Works in 1914, and in 1926 was appointed Manager of all the sewage works of the Committee.

The Council expressed their high appreciation of the services of these three gentlemen in the form of special resolutions.

Effect of the War on the Activities of the Department.

Owing to the nature of the work the Rivers Department is not able to make any spectacular contribution to the war effort, but it is assisting indirectly by carrying on the very necessary duty of helping to preserve the health of the community. The importance of this work is shown by the fact that the Department has been scheduled under the Essential Work (General Provisions) Order. The war has necessarily restricted the activities of the Department and work on the proposed scheme for the extension of the activated sludge plant at Davyhulme has had to be suspended. In the meantime, useful experimental work is being done which may have an important bearing on the design of the new works. Difficulties have been experienced owing to shortage of labour and materials, but these have not been as serious as might have been anticipated. Of a total pre-war personnel of 187, 26 are serving in H.M. Forces, and from the remainder the Department is well represented in the Home Guard and Civil Defence Services. The average age of the Department's personnel is high, and a large proportion of the men employed at the sewage works are in the "over 51" class. In some cases men have come out of retirement to take up their old jobs, and their services are greatly appreciated. As in the last war, female labour has had to be employed; about 14 women are working at Davyhulme Works.

Damage due to Enemy Action.

In January, 1941, the Committee's sludge steamship "Mancunium" was blown up by a mine and became a total loss. Fortunately, no lives were lost, and the few men who were injured made a satisfactory recovery. The loss of the "Mancunium" was a serious blow, as this ship had been responsible for the disposal at sea of about half the sewage sludge produced at Davyhulme Works. Through the great kindness of the Glasgow Corporation the Committee were able to obtain the use of the s.s. "Shieldhall" and the services of her crew: this ship made the perilous voyage from the Clyde in March, 1941, and has since given excellent service in transporting sludge from Davyhulme to sea.

A number of bombs have been dropped on the sewage works, but most of them fell in open ground and did little or no damage. The most serious damage occurred on an occasion when two bombs fell on the activated sludge plant at Davyhulme Works. One bomb damaged the compressor house and put the air filter out of action for some time. The other bomb damaged No. 2 diffused air activated sludge unit. The damage to the activated sludge unit has been turned to good account as in repairing the plant the opportunity was taken to make certain structural alterations in order that important large scale experiments could be carried out.

WORK OF THE DEPARTMENT DURING THE PERIOD UNDER REVIEW.

Surveillance of Rivers and Streams.

Under various local Acts of Parliament the Corporation, through the Rivers Committee, undertake certain duties with regard to the conservancy of rivers and streams within the City. These duties are mainly concerned with the prevention of obstruction to the flow of water, and the Corporation have powers to require riparian owners to remove obstructions and also to carry out works in order to prevent obstruction. The Corporation may also, where necessary, require the culverting of watercourses. Since 1863, when the Corporation first set up a Rivers Committee with the object of improving the River Medlock, many improvements have been made to the various rivers and streams within the City. Shortly before the war the Committee decided to embark on a programme of clearance of rivers and streams within the City, and a gang of men was organised for this purpose. Although this work would have been very useful it was decided as a measure of war economy to postpone it until after the war.

Many of the retaining walls of rivers and streams within the City are very old and occasionally, especially after severe storms, portions of these walls collapse and cause partial blockage of the river or stream. Several cases of this sort have occurred during the period under review, and in most cases riparian owners concerned have either undertaken the removal of the obstruction and the rebuilding of walls where necessary on their own account or have asked the Department to undertake the work for them. Only in a few cases has it been necessary to exercise the statutory powers of the Corporation to force riparian owners to remove obstructions. Severe damage to river walls and banks has been caused by enemy action, and this has been remedied as soon as possible by the riparian owners concerned. The condition of many old river walls and culverts continues to cause anxiety. During periodical surveys by the Department's Rivers Inspectors, a careful note has been made of dangerous portions and the owners have been advised. As a result of these representations repairs have been made in many cases which have prevented the eventual collapse of walls, and have no doubt saved the owners a good deal of money. Permission has been granted in a number of cases for the culverting of watercourses.

Surveillance of Trade Effluent.

Regular inspections have been made of trade effluents discharged to the sewers of the Corporation and of those adjoining local authorities whose sewage drains to the Manchester sewerage system. Representations have been made to a number of firms when their discharges have been regarded as unsatisfactory, and in all cases the Corporation's requirements have been met. During the period under review, two Notices under the Manchester General Powers Act, 1902, prohibiting the discharge of sulphides to the public sewer, and one under the Public Health Act, 1936, restricting the temperature of discharges to the public sewer, have been served by the Town Clerk. The firms concerned are now complying with the requirements of the Notices.

Operation of Sewage Works.

The Committee are responsible for main drainage in Manchester and for the treatment and disposal of sewage from the population of Manchester and certain adjacent districts, together with a large volume of trade effluent from a variety of industries. The whole of the sewage from Middleton, Droylsden, Cheadle and Gatley, Bramhall, Poynton, and Woodford, and part of the sewage from Audenshaw, Chadderton, Stretford, Prestwich, Urmston, Denton, and Royton is discharged to the Manchester sewerage system under agreements with the various local authorities. The total contributory population was about 820,000 in 1941, and about 781,000 in 1942.

The bulk of the sewage is treated at the Committee's main sewage works at Davyhulme in the Urban District of Urmston. The sewage from a population of about 47,000 is treated at the Committee's Withington Works at Chorlton-cum-Hardy and the sewage from Northenden is treated at a small sewage works formerly owned by the Bucklow Rural District Council. The Committee intend to close down the Northenden works when a proposed new sewer has been constructed. A small septic tank installation deals with the sewage from a number of houses at Heyhead in the Baguley district which cannot economically be connected to a sewerage system. Two sewage works, which formerly served the Moss Side and Gorton districts, have been closed down and the sewage connected to the Manchester main drainage system. The sewage works at Middleton were taken over under the Sewage Agreement between the two Corporations. These works are at present being used for the treatment of volumes of sewage in excess of four times the average dry weather flow until such time as a projected new sewer can be constructed.

No main drainage works have been carried out during the period under review, and work on the proposed scheme for extending the activated sludge plant at Davyhulme has been postponed until after the end of the war.

Details of the work done by the Department during the two years under review are given in the General Manager's report, Appendix No. I.

Expenditure.

The total charge on the rates in respect of the work of the Committee was £215,093 in 1941 and £243,154 in 1942. These sums were made up as follows :—

	1941 £		1942 £	
Revenue :—				
Central Administration	4,100		4,444	
Rivers and Streams	14,264		11,067	
Sewage Works :				
Davyhulme	39,529		48,597	
Withington	5,376		6,460	
Northenden	759		822	
Middleton, etc.	119		258	
Main Drainage	727		719	
Capital items out of Revenue	1,507	£66,381	231	£72,598
Capital (Debt Redemption) :				
Sewage Works :				
Davyhulme	47,602		50,852	
Withington	48		64	
Northenden	769		735	
Middleton, etc.	40		40	
Main Drainage	100,253	£148,712	118,865	£170,556
Total		£215,093		£243,154

	1941	1942
Rate in the £ :—		
Rivers and Streams	0·58d.	0·46d.
Main Drainage	4·10d.	5·00d.
Sewage Disposal	4·05d.	4·71d.
Total	8·73d.	10·17d.

Detailed costs are given in Tables 1 to 5, Appendix No. II.

On behalf of the Rivers Committee,

Robt. C. Rodgers,

Chairman.

Appendix No. I.

REPORT OF THE GENERAL MANAGER.

Rivers and Trade Effluent Surveillance Work.

Rivers and Streams.

During the two years under review, 109 offences, mostly of a minor nature, under local Acts have been dealt with. These were mainly concerned with obstruction of watercourses, casting of debris into streams, tipping on river banks within flood limits, and obstructions in culverts. These are summarised in Table 1 :—

TABLE 1.

Offences against Local Acts dealing with Conservancy of Rivers and Streams in Manchester.

Two Years ended 31st March, 1942.

River or Stream	Cases dealt with under Local Acts	Clearance Work undertaken			
		After service of Legal Notice	By Owners at Corporation's request	By Department at request and expense of Owners	By Department at Corporation's expense
Medlock	32	1	27	2	2
Irk	9	..	7	..	2
Gore/Chorlton ..	8	..	6	..	2
Cringle/Leigh ..	9	1	6	1	1
Alkrington ..	9	5	2	..	2
Cornbrook ..	6	..	3	..	3
Miscellaneous ..	36	2	16	4	14
Total ..	109	9	67	7	26

At various times gratings have been fixed across the inlets to certain culverts in order to collect floating debris in times of flood with the object of preventing possible blockage of the culverts. The department undertakes the clearance of these deposits and disposal of the debris. Table 2 shows the clearances effected during the period under review :—

TABLE 2.

Clearance of Gratings during the Two Years ended 31st March, 1942.

Stream.	Position of Culvert	Number of Clearances
Gore Brook	Stockport Road, Longsight ..	27
Cornbrook	Bennett Street, Ardwick ..	37
Nico Ditch	Matthews Lane, Levenshulme..	26

Floods.

The highest flood heights recorded during the period under review are given in Table 3 :—

TABLE 3.

Highest Floods in Manchester during the Two Years ended 31st March, 1942.

River	Date	Point of Measurement	Height above normal water level
River Irwell	12th November, 1940..	Broughton Bridge	12ft. 0ins.
		Sherborne Street Bridge ..	10ft. 6ins.
		Albert Bridge	5ft. 0ins.
		Regent Bridge..	3ft. 0ins.
River Medlock ..	18th October, 1941 ..	Ancoats Bridge	7ft. 0ins.
		Fairfield Street Bridge	8ft. 6ins.
		Downing Street Bridge ..	8ft. 0ins.
		Green Lane	9ft. 6ins.
		Charles Street Bridge	9ft. 0ins.
		Oxford Street Bridge	7ft. 9ins.
		" Swallow," Knott Mill.. ..	6ft. 10ins. (above cill)

Weirs on River Medlock.

The Rivers Committee undertake the maintenance of two automatic weirs on the River Medlock—Birley's Weir near Cambridge Street and Westhead's Weir near Sackville Street. Normally the river flows over the fixed part of these weirs, but when more than a certain head of flood water passes over the weir the tilting sluice gates open automatically and reduce the head of water above the weir. During the period under review the tilting gates at Westhead's Weir have been repaired. Steel plates have been fixed to the top and bottom edges and new wooden flanges have been fixed to the sides of the gates.

Collapsed Walls and Culverts.

Table 4 gives particulars of work done in connection with the repair of collapsed walls and culverts :—

TABLE 4.

Repair of Collapsed Walls and Culverts.
Two Years ended 31st March, 1942.

River or Stream	Date	Occurrence	Action taken
River Medlock	15th May, 1940	Portion of river wall collapsed into river at end of Sainsbury Street, Ancoats	Debris removed at the cost of riparian owner. No reconstruction to be done until the area is redeveloped following completion of slum clearance in this district.
	9th Nov., 1940	Parapet wall at Madder Street, Ardwick, collapsed into river	Debris removed by department at expense of riparian owner.
	13th Jan., 1941	River wall at Broughton Street, Beswick, collapsed into river together with about 20ft. of pavement	Debris removed at cost of riparian owner. Wall rebuilt by riparian owner and pavement reinstated.
	8th Mar., 1941	Parapet wall at Tetlow Street, Beswick, collapsed into river	Debris removed at cost of riparian owner. Wall not reconstructed as adjacent portion showed signs of movement. Regular inspections are being made in conjunction with the City Engineer's Department.
	5th Sept., 1941	Further collapse of river wall at Madder Street, Ardwick	Debris removed at cost of riparian owner. Lower portion of wall reconstructed and river bank sloped back. Cost apportioned between various riparian owners concerned.
Cornbrook	13th Feb., 1942	Portion of culvert collapsed under property at the corner of Cornbrook Street and Moss Lane West	Culvert repaired by City Engineer's Department at expense of riparian owner.

Damage was caused to river walls at three places, due to enemy action. In two cases debris was cleared at the same time as the general clearance of the site. In the remaining case clearance work was done with the co-operation of the department.

Widening of River Irk.

The widening of the River Irk at Collyhurst Road by the Mersey and Irwell Catchment Board was completed during 1940. This work has greatly reduced the risk of flooding at this point.

Plans approved by Committee.

During the period under review the following plans have been approved with reference to work affecting rivers and streams within the City :—

TABLE 5.

Plans approved by Rivers Committee in connection with Rivers and Streams within the City.

Two Years ended 31st March, 1942.

Year	Plans approved
1940–41	Temporary bridge over River Medlock at Mayfield.
	Variation in length of pipe under river bridge at Cambridge Street.
	Bridge over River Irk at Blackley.
	Repair of culvert at Fitzgeorge Street—Moston Brook.
	Culverting of Brownley Brook at Hollyhedge Road.
	Diversion of culvert at Openshaw—Tributary of Clayton Brook.
1941–42	Extension of existing 3ft diameter culvert, Victoria Avenue East—Alkrington Brook.
	Bridge and cables over River Irk at Blackley.
	Diversion of culvert at Blackley—Tributary of River Irk.
	Permanent private bridge over River Medlock.
	Reconstruction of river wall at Madder Street, Ardwick—River Medlock.
	Cleaning and regrading of Clayton Brook, near Crabtree Lane.

Emergency Water Supplies—National Fire Service.

The department has maintained liaison through the Rivers Inspectors with the National Fire Service. Details of various rivers and streams have been supplied to the Fire Service and advice has been given with regard to the construction of dams for the provision of emergency water supplies.

Discharge of Trade Effluent to the Public Sewer.

The admission of trade effluent to the public sewer is now regulated by the Public Health (Drainage of Trade Premises) Act, 1937, which came into operation on 1st July, 1938. This Act was referred to in the annual report for the year ended 31st March, 1939, which also contained the text of a very useful paper presented to the Institute of Sewage Purification by the former Secretary of the department, describing the operation of the Act so far as Manchester is concerned. The Corporation have always permitted the discharge of trade effluent to the sewer subject to the observance by the trader of the Corporation's regulations governing the quality of effluent discharged. When the new Act came into force the Corporation decided to bring their policy regarding trade effluent into line with the Act and to make a charge in respect of all new discharges of trade effluent. The Act provides that any trade effluent discharged to the sewer during the year ended 3rd March, 1937, may continue to be discharged without the consent of the local authority provided there is no change in the nature and composition of the trade effluent and provided that the volume of effluent discharged on any one day and the rate of discharge of trade effluent are not greater than the maximum quantity and maximum rate of flow on any one day during the year ended 3rd March, 1937. A great deal of work would require to be done in order to define the exact position of the large number of traders who discharged trade effluent into the Manchester sewers before the Act came into operation, but owing to the war it has not been found possible to do this work. Much information has, however, been obtained with regard to increased discharges of trade effluent and this task has been made much easier by the helpful co-operation of the firms concerned. In some cases, however, it has been found that traders are not aware of the Act and of their legal duty to apply to the Corporation for consent to discharge trade effluent. Where new discharges of trade effluent involve structural alterations of premises, these are, of course, disclosed to the Corporation in the plans presented to the City Architect's Department and the firms concerned are advised to apply for consent. Where a firm applies for consent to discharge trade effluent into a sewer of another local authority whose sewage drains into the Manchester main drainage system the local authority must obtain the approval of the Rivers Committee, who may specify conditions governing the discharge of the effluent just as they do within their own area.

Table 6 gives particulars of the consents issued in the Manchester Drainage District under the Public Health (Drainage of Trade Premises) Act, 1937, during the period under review :—

TABLE 6.

Consents Issued in the Manchester Drainage District under the Public Health (Drainage of Trade Premises) Act, 1937, during the Two Years ended 31st March, 1942.

Year	Authority	Number of consents issued	Agreed maximum daily volume (gallons)	Average daily volume discharged during year (gallons)
1940–41	Manchester	5	307,000	59,000
	Cheadle and Gatley ..	2	55,000	27,000
	Urmston	3	590,000	113,000
	Stretford	1	50,000	42,000
		Total.. 11	1,002,000	241,000
1941–42	Manchester	5	97,500	50,000
	Stretford	1	480,000	14,000
	Urmston	1	480,000	41,000
		Total.. 7	1,057,500	105,000

In addition, consents have been issued in respect of minor discharges of trade effluent, that is to say, volumes less than 1,000 gallons per day, as follows :—

TABLE 7.

Consents Issued in respect of Minor Discharges of Trade Effluent. Two Years ended 31st March, 1942.

Authority	Number of consents issued	
	1940–41	1941–42
Manchester..	14	11
Stretford	1	1
	15	12

Trade Effluent Surveillance.

Table 8 gives details of the examination of trade effluent made during the two years ended 31st March, 1942 :—

TABLE 8.

Examination of Trade Effluent Discharged to the Public Sewer.
Two Years ended 31st March, 1942.

Year	District	Number of Inspections	Number of Unsatisfactory Samples
1940–41	Manchester	1,585	29
	Cheadle and Gatley	3	..
	Droylsden	36	..
	Middleton	11	..
	Stretford	348	2
	Urmston	79	2
		Total.. 2,062	33
1941–42	Manchester	898	10
	Cheadle and Gatley	5	..
	Droylsden	5	..
	Middleton	7	..
	Stretford	153	4
	Urmston	42	..
		Total.. 1,110	14

OPERATION OF SEWAGE WORKS.

Davyhulme Works.

The Davyhulme Works have been described in detail in former annual reports and in other publications of the department, therefore it is only necessary to give a brief outline of the processes involved in the treatment of the sewage.

Sewage discharged to the works is made up of domestic sewage, trade effluent, and sub-soil water which finds its way into the sewerage system. As the bulk of the area draining to the works is sewered on the combined system, the volume of sewage discharged to the works varies with the rainfall. Near the inlet to the sewage works there is an overflow cill 50ft. long. Downstream of this cill there is an automatic penstock which limits the volume of sewage passing for full treatment to a maximum rate of three-and-one-third million gallons per hour from 10 a.m. to 10 p.m. and two million gallons per hour from 10 p.m. to 10 a.m. These limiting volumes were arrived at from a study of the variation in the rate of flow of sewage to the works over a long period prior to the construction of the activated sludge plant and were agreed with the Lancashire Rivers Board. Sewage in excess of three-and-one-third million gallons per hour in the daytime and two million gallons per hour at night passes over the overflow cill and is distributed to eight storm-water sedimentation tanks having a total capacity of about eleven million gallons. The effluent from the storm-water tanks is discharged to the Ship Canal by a separate outlet.

The sewage which receives full treatment passes through a system of detritus tanks, then through vertical fixed screens consisting of 1in. bars at 4in. centres, and is then distributed to ten rectangular horizontal flow sedimentation tanks with a total capacity equivalent to 7½ hours dry weather flow. Eight of the sedimentation tanks have been in use since 1902 ; the other two are of modern design and are fitted with a Mieder type scraper which is used for the removal of scum from the surface of the sewage and sludge from the floor of the tanks. About half the effluent from the sedimentation tanks is purified in the activated sludge plant and the remainder is treated in 46 acres of primary contact bacteria beds and 39 acres of secondary contact bacteria beds. The effluent from the activated sludge plant is discharged to the Ship Canal just below Barton Locks and the effluent from the contact beds is discharged further down the Canal.

About two-fifths of the surplus activated sludge from the activated sludge plant is pumped to the inlet channel of the sedimentation tanks and is settled out along with the ordinary sewage solids. The remainder of the surplus activated sludge, after separation of a large volume of water, is pumped to Flixton and Carrington and broadcast over prepared areas of land. Most of the sludge from the sedimentation tanks is taken to sea in a sludge steamship and deposited in Liverpool Bay. A relatively small amount of mixed surplus activated sludge and sludge from sedimentation tanks is treated in a heated sludge digestion plant and since March, 1941, sludge has been pumped to the new sludge storage lagoons at Flixton, which are operated as open unheated sludge digestion tanks.

Treatment of Sewage.

Table 9 gives statistics relating to the volume of sewage treated during the two years under review :—

TABLE 9.

Volume of Sewage Discharged to Davyhulme Works and Rainfall in Manchester and District for the Two Years ended 31st March, 1942.

	1940–41	1941–42
Total volume of sewage discharged to works (gallons) . .	21,496,864,000	20,604,539,000
Average volume per day (gallons)	58,895,000	56,451,000
Population draining to works	770,000	731,000
Average volume per day per head of contributory population (gallons)	76	77
RAINFALL (inches)—		
Davyhulme	31·91	26·94
Chorlton	24·58	23·30
Platt Fields	31·27	26·34
Heaton Park	38·02	33·97

The sewage was dealt with as shown in Table 10 :—

TABLE 10.

Treatment of Sewage at Davyhulme Works—Two years ended 31st March 1942.

Volume (gallons)		Average Daily Volume (gallons)		Percentage of Total Volume		Method of Treatment
1940–41	1941–42	1940–41	1941–42	1940–41	1941–42	
2,501,370,000	1,394,500,000	6,853,000	3,821,000	11·6	6·8	Settled in storm-water tanks (storm water).
2,417,200,000	978,800,000	6,623,000	2,680,000	11·3	4·7	Settled in sedimentation tanks.‡
2,440,895,000	5,086,812,000	6,687,000	13,937,000	11·4	24·7	Settled in sedimentation tanks and treated in primary contact beds only.
4,847,105,000	4,619,988,000	13,280,000	12,658,000	22·5	22·4	Settled in sedimentation tanks and treated in primary and secondary contact beds.
233,228,000	221,614,000	639,000	607,000	1·1	1·1	Settled in sedimentation tanks and treated in activated sludge (Bioaeration) plant.
446,394,000	469,273,000	1,223,000	1,286,000	2·1	2·3	Settled in sedimentation tanks and treated in activated sludge (Simplex) plant.
8,610,672,000	7,833,552,000	23,591,000	21,462,000	40·0	38·0	Settled in sedimentation tanks and treated in activated sludge (Diffused Air) plant.

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‡ Tank effluent which could not be given further treatment owing to bomb-damaged plant.

Composition of Sewage.

Table 11 gives the average composition of the sewage after the removal of heavy grit, etc., in the detritus tanks. The sewage is of more than average strength owing to the presence of trade effluent.

TABLE 11.

Average Composition of Sewage Treated at Davyhulme Works during the Two Years ended 31st March, 1942.

		1940–41	1941–42
Ammoniacal nitrogen	(parts per 100,000)	3·01	3·07
Albuminoid nitrogen	,, ,,	0·86	0·85
Chlorine in chlorides	,, ,,	25·6	26·8
Oxygen absorbed from N/80 permanganate in four hours at 26·7°C.	,, ,,	10·24	11·08
Biochemical oxygen demand	,, ,,	22·23	23·89
Solid matter in suspension :—			
Organic and volatile	,, ,,	15·3	14·9
Mineral matter (residue after ignition) ..	,, ,,	6·1	7·1
Total		21·4	22·0

Storm-water Tanks and Sedimentation Tanks.

From Table 10 it will be seen that the volume of storm water separated at the storm-water overflow on the main sewage channel was equivalent to 11·6 per cent. of the total flow during the year ended 31st March, 1941, and 6·8 per cent. during the year ended 31st March, 1942. Owing to damage to one of the main tank effluent carriers and also to the activated sludge plant, due to enemy action, the whole of the effluent from the sedimentation tanks could not be dealt with in the contact beds or in the activated sludge plant. Volumes of tank effluent, equivalent to 11·3 per cent. of the total flow in 1940–41 and 4·7 per cent. in 1941–42, had to be discharged to the Ship Canal without further treatment. Table 12 shows the average composition of effluent from the sedimentation tanks.

TABLE 12.

Average Composition of Effluent from Sedimentation Tanks at Davyhulme Works during the Two Years ended 31st March, 1942.

		1940–41	1941–42
Ammoniacal nitrogen	(parts per 100,000)	3·11	3·05
Albuminoid nitrogen	,, ,,	0·65	0·61
Chlorine in chlorides	,, ,,	27·6	26·5
Oxygen absorbed from N/80 permanganate at 26·7°C. in :—			
Three minutes	,, ,,	3·89	4·10
Four hours	,, ,,	9·16	9·55
Biochemical oxygen demand	,, ,,	14·10*	15·10*
Solid matter in suspension :—			
Organic and volatile	,, ,,	6·8	5·7
Mineral matter (residue after ignition) ..	,, ,,	2·6	2·2
Total		9·4	7·9

* Sedimentation tank effluent as discharged to activated sludge plant.

Contact Bacteria Beds.

The contact bacteria bed installation consists of 46 acres of primary beds which have been in operation since 1904 and 39 acres of secondary beds which have been in operation since 1907. In addition, 27 acres of similar filter beds were used at one time for the filtration of effluent from the storm-water tanks, but operation of these storm-water filter beds was abandoned many years ago as the additional purification effected was not worth the expense involved. In operating the double contact bacteria beds tank effluent is run into the primary beds and after a short period of detention is then discharged to the secondary beds where further purification takes place. During the resting period between fillings the organic matter precipitated from the sewage and retained in the contact beds is to some extent oxidised. When the existing activated sludge plant was brought into commission it was thought that the contact bed installation would be able to deal with half of the effluent from the sedimentation tanks for a number of years, provided the filtering material was washed and renewed at regular intervals. When the activated sludge plant was found to be most efficient and economical in operation, it was decided to extend the activated sludge plant to treat the whole of the tank effluent and the costly washing and renewing of the filtering material in the contact beds was abandoned. Owing to the gradual accumulation of solid matter derived from the sewage, particularly in the primary contact beds, the capacity of the beds and their efficiency have been greatly reduced and the volume of tank effluent passed through the contact beds at the present time is greatly in excess of their purification capacity. The whole of the effluent from the primary contact beds is not passed through the secondary beds as it is considered desirable to obtain as good an effluent as possible from the secondary beds. The average results of treatment in the primary contact beds are given in Table 13 and the average results of treatment in the primary and secondary beds are given in Table 14.

TABLE 13.

Average Results of Treatment of
Settled Sewage in Primary Contact Bacteria Beds at Davyhulme Works.
Two Years ended 31st March, 1942.

	1940–41			1941–42		
	Series 1	Series 2	Series 3	Series 1	Series 2	Series 3
Average composition of effluent (parts per 100,000) :—						
Ammoniacal nitrogen	2·64	2·51	2·55	2·56	2·47	2·64
Albuminoid nitrogen	0·43	0·43	0·40	0·37	0·37	0·39
Nitrous nitrogen	0·04	0·03	0·03	0·03	0·03	0·02
Nitric nitrogen	0·19	0·19	0·21	0·21	0·27	0·18
Chlorine in chlorides	22·7	24·1	25·4	24·2	24·6	25·1
Oxygen absorbed from N/80 permanganate in four hours at 26·7°C.	5·85	6·21	5·58	6·10	6·02	6·47
Solid matter in suspension	4·4	4·9	5·3	3·6	3·7	4·5
Putrescibility on incubation for six days at 26·7°C. :—						
Number of samples— Putrescible	24	34	34	22	22	36
Doubtful	1	5	4	7	7	6
Non-putrescible	12	12	13	23	23	10

NOTE.—From October 10th, 1940, to January 23rd, 1941, Series 1 not in operation owing to bomb damage to carrier.

TABLE 14.

Average Results of Treatment of
Settled Sewage in Primary and Secondary Contact Bacteria Beds at Davyhulme Works.
Two Years ended 31st March, 1942.

	1940–41		1941–42	
	Series A	Series B	Series A	Series B
Average composition of effluent (parts per 100,000) :—				
Ammoniacal nitrogen	1·76	1·93	1·97	2·19
Albuminoid nitrogen	0·22	0·24	0·22	0·28
Nitrous nitrogen	0·04	0·03	0·03	0·02
Nitric nitrogen	0·65	0·31	0·48	0·18
Chlorine in chlorides	21·7	20·7	23·9	22·9
Oxygen absorbed from N/80 permanganate in four hours at 26·7°C.	2·54	2·83	3·08	3·91
Biochemical oxygen demand	3·39	4·07	3·92	5·49
Solid matter in suspension	3·2	2·9	3·6	3·6
Putrescibility on incubation for six days at 26·7°C. :—				
Number of samples—				
Putrescible	5	25	6	55
Doubtful	3	1	2	4
Non-putrescible	91	74	91	33
Purification effected on sewage (per cent.) :—				
Reduction in—				
Oxygen absorbed from permanganate	75	72	72	65
Albuminoid nitrogen	75	73	74	67
Biochemical oxygen demand	85	85	84	77
Purification effected on settled sewage (per cent.) :—				
Reduction in—				
Oxygen absorbed from permanganate	72	69	68	59
Albuminoid nitrogen	66	63	64	54

Activated Sludge Plants.

The main activated sludge plant is operated on the Diffused Air system which was originated and developed at Manchester Sewage Works. This plant, which came into operation in 1935, consists of seven units, each of which comprises a system of aeration tanks and settlement tanks. Six of the aeration tanks are used for aerating the mixture of sewage and activated sludge and the remaining unit is used for reaerating returned activated sludge. Each aeration tank is divided longitudinally into three channels which are connected in series so that the mixture of settled sewage and activated sludge undergoing treatment travels along a channel, 15 feet wide by 1,062 feet long with a normal working depth of 15 feet.

Two of the Diffused Air units were so constructed that they could be operated independently of the other units and of one another in order that different methods of operating the plant could be tried out on a relatively small scale. As stated earlier, one of these independent units, No. 2 unit, was damaged by enemy action early in 1941 and in repairing this unit alterations were made to enable the three aeration channels, each 354 feet long, to be operated in parallel with a common outlet to the settlement tanks. Settled sewage supplied to this unit and also the returned activated sludge is divided equally among the three channels. Apart from these alterations, Nos. 1 and 2 independent units are similar in every respect, so it should be possible to obtain a direct comparison of the relative efficiency of treating settled sewage by the Diffused Air process in two aeration tanks of the same capacity, in one case with the three channels connected in series and in the other case with the three channels in parallel.

Compressed air is supplied to the diffusers in the aeration tanks by three Reavell turbo-blowers which are capable of supplying air at a maximum pressure of 12 pounds per square inch. The average pressure of the air supplied to the aeration tanks during the year ended 31st March, 1941, was 8·59 pounds per square inch, but during the year ended 31st March, 1942, the average pressure was 10·06 pounds per square inch. This relatively large increase in average air pressure was to a large extent due to damage to the plant by enemy action. The air filters were out of action for a long period and no doubt a considerable amount of fine dust and soot was drawn into the system. It should also be noted that it has been impossible owing to the war to renew the diffusers at the proper time. The department budgeted for the renewal of diffusers at the end of five years of operation and the plant had actually been in operation for six years before increased resistance in the diffusers caused the pressure to rise very high above the original working pressure. The diffusers in individual units will be renewed as soon as possible. The average volume of air used for the aeration of sewage, reaeration of returned activated sludge, and for the pumping of returned activated sludge by the air lift pumps was equivalent to 0·91 cubic foot per gallon of sewage treated in 1940–41 and 1941–42.

In addition to the Diffused Air plant there are two smaller activated sludge plants in which aeration is effected by mechanical means. One plant which deals with an average volume of settled sewage of about 600,000 gallons per day is operated on the Bioaeration system developed at Sheffield. The other plant which deals with an average volume of about 1,250,000 gallons per day is operated on the Simplex surface aeration system.

The operation of all the activated sludge plants has been consistently satisfactory during the period under review; the results are given in Tables 15 and 16.

TABLE 15.

Average Results of Operation of Activated Sludge Plants at Davyhulme Works.
Year ended 31st March, 1941.

	Bio-aeration Plant	Simplex Plant	Diffused Air Plant		
			Unit 1	Unit 2	Units 3–7
Average volume of settled sewage treated per day (gallons)	639,000	1,223,000	3,279,000	3,369,000	17,183,000
Average detention period in aeration tanks (hours)	17·3	13·1	10·1	9·8	9·6
Average horse-power used per million gallons..	44·0	28·4	30·8	30·4	29·4
Average composition of effluent (parts per 100,000) :—					
Ammoniacal nitrogen	2·44	2·44	2·49	2·47	2·52
Albuminoid nitrogen	0·15	0·16	0·15	0·15	0·15
Nitrous nitrogen	0·03	0·03	0·03	0·03	0·03
Nitric nitrogen	0·16	0·15	0·14	0·13	0·12
Chlorine in chlorides	24·1	24·6	23·9	24·4	23·6
Oxygen absorbed from N/80 permanganate in four hours at 26·7°C.	2·00	2·12	1·95	2·00	1·90
Biochemical oxygen demand ..	1·50	1·66	1·20	1·33	1·18
Solid matter in suspension ..	1·4	1·4	1·4	1·5	1·5
Putrescibility of effluent on incubation for six days at 26·7°C. :—					
Number of samples—					
Putrescible	14	17	Nil	4	Nil
Doubtful	8	8	Nil	6	Nil
Non-putrescible	343	340	365	355	365
Purification effected on sewage (per cent.) :—					
Reduction in—					
Oxygen absorbed from permanganate	80·5	79·3	81·0	80·5	81·5
Albuminoid ammonia	82·5	81·3	82·5	82·5	82·5
Biochemical oxygen demand ..	93·3	92·5	94·6	94·0	94·7
Purification effected on settled sewage (per cent). :—					
Reduction in—					
Oxygen absorbed from permanganate	71·5	69·8	72·2	69·8	72·9
Albuminoid ammonia	73·5	71·7	73·5	73·5	73·5
Biochemical oxygen demand ..	89·4	88·2	91·5	90·6	91·6

Table 16.

Average Results of Operation of Activated Sludge Plants at Davyhulme Works.
Year ended 31st March, 1942.

	Bio-aeration Plant	Simplex Plant	Diffused Air Plant		
			Unit 1	Unit 2	Units 3–7
Average volume of settled sewage treated per day (gallons)	607,000	1,286,000	3,454,000	OUT OF COMMISSION	18,008,000
Average detention period in aeration tanks (hours)	18·2	12·5	9·6		9·2
Average horse-power used per million gallons	44·4	28·7	33·0		31·7
Average composition of effluent (parts per 100,000):—					
Ammoniacal nitrogen	2·57	2·58	2·60		2·59
Albuminoid nitrogen	0·16	0·17	0·17		0·17
Nitrous nitrogen	0·03	0·03	0·03		0·03
Nitric nitrogen	0·13	0·15	0·12		0·13
Chlorine in chlorides	25·8	26·3	25·8		25·5
Oxygen absorbed from N/80 permanganate in four hours at 26·7°C.	2·17	2·28	2·26		2·22
Biochemical oxygen demand . .	1·52	1·63	1·47		1·39
Solid matter in suspension	1·5	1·5	1·6		1·6
Putrescibility of effluent on incubation for six days at 26·7°C. :—					
Number of samples—					
Putrescible	Nil	Nil	Nil		Nil
Doubtful	Nil	Nil	Nil		Nil
Non-putrescible	365	365	365		365
Purification effected on sewage (per cent.) :—					
Reduction in—					
Oxygen absorbed from permanganate	80·4	79·4	79·6		80·0
Albuminoid nitrogen	81·0	80·4	80·4		80·4
Biochemical oxygen demand . .	93·6	93·2	93·8		94·2
Purification effected on settled sewage (per cent.) :—					
Reduction in—					
Oxygen absorbed from permanganate	72·5	71·1	71·3		71·8
Albuminoid nitrogen	73·1	72·3	72·3		72·3
Biochemical oxygen demand . .	89·9	89·2	90·3		90·8

Average Works Effluent.

The average composition of the effluent discharged from all sections of the treatment plant at Davyhulme Works, including settled sewage which has had no further treatment, is shown in Table 17:—

TABLE 17.

Average Composition of Effluent from Davyhulme Works.
Two Years ended 31st March, 1942.

		1940–41	1941–42
Ammoniacal nitrogen	(parts per 100,000)	2·36	2·49
Albuminoid nitrogen	,, ,,	0·25	0·27
Nitrous nitrogen	,, ,,	0·03	0·03
Nitric nitrogen	,, ,,	0·22	0·19
Chlorine in chlorides	,, ,,	23·2	24·8
Oxygen absorbed from N/80 permanganate in four hours at 26·7°C.	,, ,,	3·28	3·90
Solid matter in suspension	,, ,,	3·2	3·2
Purification effected on sewage (per cent.):—			
Reduction in—			
Oxygen absorbed from permanganate		68	67
Albuminoid nitrogen		72	68

Disposal of Sludge.

The total amount of sludge removed for final disposal was 351,315 tons in 1940–41 and 415,820 tons in 1941–42. These amounts are equivalent to 16·34 tons and 20·17 tons respectively per million gallons of sewage discharged to the works. In addition 39,500 tons of detritus were removed from the detritus tanks in 1940–41 and 38,810 tons in 1941–42. The sludge and detritus were dealt with as shown in Table 18:—

TABLE 18.

Disposal of Sludge and Detritus at Davyhulme Works.
Two Years ended 31st March, 1942.

Type of Sludge	Amount (tons)		Equivalent amount of dry matter (tons)		Method of Disposal
	1940–41	1941–42	1940–41	1941–42	
Detritus	39,500	38,810	..	..	Tipped on site of disused storm beds and covered with soil.
Sedimentation tank and storm-water tank sludge	174,500	133,510	14,309	12,000	Pumped to storage tanks and sent to sea.
Ditto	32,125	15,180	2,736	1,366	Pumped to storage tanks and broadcast on land areas.
Ditto	..	69,760	..	6,280	Pumped to storage tanks and sent to lagoons at Flixton.
Digested sludge	15,790	12,290	1,000	900	Pumped to storage tanks and sent to sea.
Ditto	12,775	2,100	810	153	Pumped to storage tanks and sent to land.
Ditto	2,655	6,950	171	509	Pumped to storage tanks and sent to lagoons.
Ditto	..	400	..	29	Pumped to draining beds.
Densified activated sludge	113,470	172,910	2,174	2,960	Pumped to storage tanks and broadcast on land areas.
Ditto	..	2,720	..	47	Pumped to storage tanks and sent to draining beds.

Detritus.

Although the method of tipping detritus and covering with soil is not an ideal method of disposal of this material, it has been carried out at Davyhulme for many years without causing nuisance. Consideration is being given to more hygienic methods of dealing with this material.

Sedimentation Tank and Storm-water Tank Sludge.

With the exception of the two new tanks fitted with Mieder sludge scrapers, all the sedimentation tanks and storm-water tanks at Davyhulme have to be cleaned by manual labour. The sludge in the sedimentation tanks is a mixture of primary sludge and surplus activated sludge which is pumped from the activated sludge plant to the inlet to the sedimentation tanks. The average water content of the sludge removed from sedimentation tanks Nos. 1 to 8 is 91·1 per cent. The average water content of the sludge removed from tanks Nos. 17 and 18 is 94·0 per cent. and the average water content of the sludge removed from the storm-water tanks is 89·2 per cent. As will be seen from Table 18, the bulk of the sludge from the sedimentation tanks and storm-water tanks is disposed of at sea.

Between 1st April, 1940, and 15th January, 1941, the sludge steamship " Mancunium " made 149 trips and in addition the " Salford City " made 33 trips up to October, 1940, when the agreement between the two Corporations regarding the use of the " Salford City " came to an end. When the " Mancunium " was lost as a result of enemy action on 15th January, 1941, negotiations were immediately started with the Glasgow Corporation for the charter of one of their sludge steamships, the s.s. " Shieldhall," and this ship began work at Manchester on the 31st March, 1941. From January to March, 1941, sludge from the sedimentation tanks and storm-water tanks was disposed of on land at Flixton and Carrington. From 31st March, 1941, to 31st March, 1942, the s.s. " Shieldhall " made 109 trips.

Surplus Activated Sludge.

The total amount of surplus activated sludge discharged from the activated sludge plant was 1,327,410 tons in 1941 and 1,286,000 tons in 1942. These amounts were equivalent to 7,616 and 7,690 tons of dry matter respectively. About two-fifths of the surplus activated sludge was pumped to the inlet to the sedimentation tanks and settled out with the ordinary sewage solids. The remainder was densified by treatment in a picket fence thickener followed by settlement in storage tanks. Most of the densified sludge was pumped to Flixton or Carrington, broadcast on land, and ploughed in when dry ; the remainder was pumped to the sludge digestion plant. Table 19 shows the amount of surplus activated sludge dealt with.

TABLE 19.

Treatment and Disposal of Surplus Activated Sludge.
Two Years ended 31st March, 1942.

	Amount (tons)		Equivalent amount of dry matter (tons)	
	1940–41	1941–42	1940–41	1941–42
Sludge pumped to primary sedimentation tanks	494,030	463,389	3,960	3,746
Water separated at picket fence thickener	451,770	381,746	..	..
Water separated at storage tanks ..	194,920	211,175	..	..
Densified sludge broadcast on land..	113,470	172,910	2,174	2,960
Densified sludge pumped to sludge digestion plant	73,220	54,060	1,482	937
Densified sludge pumped to draining beds	..	2,720	..	47
Total	1,327,410	1,286,000	7,616	7,690

Sludge Digestion.

The sludge digestion plant at Davyhulme was designed to treat about 100,000 tons per annum of a mixture of sedimentation tank sludge and surplus activated sludge. The plant is operated in such a way as to treat as much activated sludge as possible in the shortest possible time and to obtain the maximum separation of water. The plant was put down as a large scale experiment to determine the practicability of this process as a preliminary to the disposal of surplus activated sludge either by broadcasting on land or shipping to sea.

The performance of the plant during the period under review is summarised in Table 20 :—

TABLE 20.

Operation of Sludge Digestion Plant.
Two Years ended 31st March, 1942.

	1940–41 Amount (tons)	1941–42 Amount (tons)
I. Mixing Tanks—		
Input of activated sludge	73,220	54,060
Input of sedimentation tank sludge	26,800	25,040
Total input	100,020	79,100
Water withdrawn	740	250
Sludge transferred to Digesters	99,280	78,850
Dry solids in sludge transferred	3,183	3,095
Dry organic matter in sludge transferred	2,126	2,012
II. Primary Digestion Tanks, 80-85° Fah.—		
Amount discharged :		
(*a*) From 6ft. and 12ft. levels		
Total amount	68,175	55,150
Dry solid matter	770	1,007
Dry organic matter	481	619
(*b*) From bottom of tanks		
Total amount	31,105	23,700
Dry solid matter	1,585	1,031
Dry organic matter	914	592
Total amount discharged	99,280	78,850
Total dry solid matter	2,355	2,038
Total dry organic matter	1,395	1,211
III. Secondary Digestion Tanks—		
Supernatant water removed and returned to sewage treatment plant	67,760	57,110
Supernatant water removed at storage tanks prior to final disposal	300	Nil
Total digested sludge removed	31,520	21,740
Total dry solid matter	1,981	1,591
Total dry organic matter	1,172	931

During the year ended 31st March, 1941, the plant worked normally ; the average detention period in the heated tanks was 13 days and the overall reduction in volume of the mixed sludge fed to the plant was 68·5 per cent. During the second half of 1941 extensive corrosion was discovered in the tubes of the Cochran boiler of the heating plant. The boiler had to be retubed during December, 1941, and January, 1942. While the heating plant was out of commission the temperature of the sludge in the digesters fell to 50° Fah. and it was a considerable time before active digestion was again established. Later it was discovered that some of the down pipes leading to the heating coils were fractured and in March, 1942, one of the digesters was put out of commission. For all these reasons the amount of mixed sludge digested during the year ended 31st March, 1942, was much less than usual and the average detention period in the heated tanks was 19 days. The separation of water from the sludge dealt with was good ; the average reduction in volume was 72 per cent.

The primary digestion tanks are covered by gasholder type roofs and the gas is burned under a Cochran boiler to heat the water which is circulated through the sludge preheater and the primary digestion tanks. The total volume of gas recorded was 14,911,300 cu.ft. in 1941 and 10,910,100 cu. ft. in 1942. These volumes represent 3·1 cu. ft. and 2·42 cu. ft. per lb. of dry organic matter respectively in the sludge supplied to the primary digestion tanks. Almost all the gas was used for heating purposes and the amount wasted to atmosphere was 461,800 cu. ft. in 1941 and 199,900 cu. ft. in 1942.

Sludge Draining Beds.

Four acres of old storm-water filters adjacent to the sludge digestion plant were converted into sludge draining beds as part of the department's emergency provisions for sludge disposal following the loss of the s.s. "Mancunium." Some of the old medium was removed and replaced with new medium, and the underdrains repaired where necessary.

Another old storm-water filter was emptied and converted into an additional sludge digestion tank and a 4in. sludge pump was installed in a small pump house constructed in one corner of this tank. Digested sludge can be pumped from this tank or from the sludge digestion plant to the draining beds and also sludge from the sedimentation tanks can be discharged on to the beds by means of the sludge ejectors. Operation of these beds should provide useful information on the drying of sludge in the open air.

Sludge Lagoons at Flixton.

Early in 1940 the Rivers Committee approved a scheme for the construction of five sludge lagoons at Flixton to provide for the emergency storage of sludge in case of accident to the sludge steamship. Owing to unfavourable weather conditions and labour difficulties little progress had been made with the construction of these lagoons when the "Mancunium" was lost in January, 1941. The banks of the lagoons were constructed of top soil obtained by shallow excavation by dragline and bulldozer, and were consolidated by the bulldozer. The soil was somewhat mixed and consequently there was danger of percolation through the banks at places where there was a high proportion of sand in the soil. These places were afterwards strengthened by inserting puddle cores. The banks of some of the lagoons were pitched with rubble to minimise erosion due to wave action at the water line. The lagoons were designed originally as five separate lagoons, but during construction the design was altered to enable them to be used as sludge digestion lagoons. The lagoons are in two groups; one group comprises comprises two primary lagoons and one secondary lagoon, the other one primary lagoon and one secondary lagoon. Provision was made for discharging supernatant water or sludge from the primary lagoons to the secondary lagoons and outlet chambers were provided for each of the secondary lagoons at which water can be withdrawn from different levels in the lagoons and sludge can be withdrawn from the bottom and discharged on to adjacent land.

The total area of the five lagoons is 11½ acres and the average working depth 8ft. The maximum capacity of the five lagoons is 95,000 tons, which is equivalent to the amount of sludge normally sent to sea in the "Mancunium" during six months. The lagoons were first brought into commission in March, 1941, and were supplied with a mixture of primary sludge and digested sludge. When active digestion was established primary sludge only was pumped to the lagoons as convenient. From 20th March, 1941, to 31st March, 1942, 79,365 tons of sludge were pumped into the lagoons and during the same period 11,850 tons of supernatant water were separated and allowed to percolate through adjacent areas of land.

Farming.

Six acres at Davyhulme Works and about 46 acres at Flixton and Carrington were farmed during the period under review, and good crops were obtained of wheat, oats, hay, potatoes, and swedes. The income from the sale of crops produced during the years 1940–41 and 1941–42 was about £300 and £900 respectively.

Withington Works.

The sewage from a population of about 47,000 in the districts of Chorlton-cum-Hardy, Levenshulme, and Rusholme is treated at the Withington Works. The sewage of Chorlton-cum-Hardy reaches the works through a low level sewer and is pumped to the treatment plant, the remainder of the sewage reaches the works by gravity through a high level sewer. The method of treatment is similar to that at Davyhulme, but a much larger proportion of the sewage is treated by the activated sludge process. There are two activated sludge units—No. 1 unit, which has been in continuous operation since 1917 and is the first large-scale activated sludge plant ever constructed; and No. 2 unit, which was constructed in 1923. Much fundamental experimental work has been done with these plants, results of which have provided data for the construction of activated sludge plants at many sewage works. The settlement tank of No. 2 unit is not very efficient, partly because the activated sludge is difficult to settle and partly because the unit is treating more than the designed volume of sewage. Effluent from both the activated sludge units is now passed through a number of contact beds which act as straining filters. Eleven acres of primary and secondary contact beds are still in use for the treatment of settled sewage and storm-water.

Treatment of Sewage.

Table 21 gives statistics relating to the volume of sewage treated during the two years under review :—

TABLE 21

Volume of Sewage Discharged to Withington Works and Rainfall at Chorlton.
Two Years ended 31st March, 1942.

	1940–41	1941–42
Total volume of sewage discharged to works (gallons) . .	719,732,000	718,095,000
Average volume per day (gallons)	1,971,900	1,967,000
Population draining to works (approx.)	47,000	47,000
Average volume per day per head of contributory population (gallons)	42	42
Rainfall at Chorlton (inches)	29·47	24·43

The sewage was dealt with as follows :—

TABLE 22.

Treatment of Sewage at Withington Works.
Two Years ended 31st March, 1942.

Volume (gallons)		Average Daily Volume (gallons)		Percentage of Total Volume		Method of Treatment
1940–41	1941–42	1940–41	1941–42	1940–41	1941–42	
33,161,000	34,791,000	90,900	95,300	4·6	4·8	Settled in sedimentation tanks and treated in storm-water filters.
60,438,000	51,147,000	165,600	140,100	8·4	7·1	Settled in "Emscher" tank and treated in primary and secondary contact beds.
114,328,000	116,702,000	313,200	319,800	15·9	16·3	Settled in sedimentation tanks and treated in primary and secondary contact beds.
78,131,000	82,887,000	214,000	226,000	10·8	11·5	Treated in No. 1 unit, activated sludge plant.
433,674,000	432,568,000	1,188,200	1,185,100	60·3	60·3	Treated in No. 2 unit, activated sludge plant.

Composition of Sewage.

Table 23 gives the average composition of sewage after removal of detritus. The sewage is mainly domestic and is of average strength.

TABLE 23.

Average Composition of Sewage Treated at Withington Works.
Two Years ended 31st March, 1942.

		1940–41	1941–42
Ammoniacal nitrogen	(parts per 100,000)	2·89	3·09
Albuminoid nitrogen	,, ,,	0·58	0·62
Chlorine in chlorides	,, ,,	8·9	9·3
Oxygen absorbed from N/80 permanganate in four hours at 26·7°C.	,, ,,	3·67	3·74
Biochemical oxygen demand	,, ,,	17·41	19·90
Solid matter in suspension	,, ,,	7·9	8·1

Contact Bacteria Beds.

The contact beds used for the treatment of storm-water dealt with storm-water at the rate of 36,340 gallons per acre per day in 1941 and 38,108 gallons per acre per day in 1942. Settled sewage treated in primary and secondary contact beds was applied to the primary beds at the rate of 114,000 gallons per acre per day in 1941 and 105,000 gallons per acre per day in 1942. At these rates the contact beds were not overloaded and produced a fairly good effluent. A considerable amount of labour was required, however, for cleaning the surface of the contact beds.

Activated Sludge Plant.

The operation of the activated sludge plant was satisfactory throughout the period under review. Details of the operation of this plant are given in Table 24 :—

TABLE 24

Results of Operation of Activated Sludge Plant at Withington Works.
Two Years ended 31st March, 1942.

	1940–41	1941–42
Average volume of sewage treated per day :		
No. 1 unit	214,000	227,100
No. 2 unit	1,198,000	1,185,100
Average detention period in aeration tanks (hours) :		
No. 1 unit	7·0	6·6
No. 2 unit	5·2	5·2
Average air consumption (cu. ft. per gallon) :		
No. 1 unit	1·74	1·66
No. 2 unit	0·85	0·87
H.P. per million gallons :		
No. 1 unit	59·3	58·0
No. 2 unit	28·9	30·4
Average composition of effluent (parts per 100,000) :		
Ammoniacal nitrogen	2·25	2·43
Albuminoid nitrogen	0·13	0·14
Nitrous nitrogen	0·01	0·01
Nitric nitrogen	0·19	0·15
Chlorine in chlorides	8·6	9·2
Oxygen absorbed from N/80 permanganate in four hours at 26·7°C.	0·85	0·87
Biochemical oxygen demand	1·28	1·46
Solid matter in suspension	1·3	1·0
Putrescibility on incubation for six days at 26·7°C. :—		
Number of samples—		
Putrescible	4	29
Doubtful	11	22
Non-putrescible	347	309

N.B.—In 1940–41, 80 per cent. and in 1941–42, 91 per cent. of effluent from the activated sludge plant was passed through straining filters.

Average Works Effluent.

The effluent from the contact beds and the effluent from the activated sludge plant are combined before being discharged to the Chorlton Brook. The average composition of the effluent discharged to the brook is shown in Table 25 :—

TABLE 25.

Average Composition of Effluent from Withington Works.
Two Years ended 31st March, 1942.

	1940–41	1941–42
Average composition (parts per 100,000) :		
Ammoniacal nitrogen	2·03	2·24
Albuminoid nitrogen	0·14	0·15
Nitrous nitrogen	0·02	0·02
Nitric nitrogen	0·28	0·24
Chlorine in chlorides	8·6	9 0
Oxygen absorbed from N/80 permanganate in four hours at 26·7°C.	0·91	0·94
Biochemical oxygen demand	1·55	1·71
Solid matter in suspension	1·3	1·0
Putrescibility on incubation for six days at 26·7°C. :—		
Number of samples—		
Putrescible	2	24
Doubtful	8	18
Non-putrescible	352	318
Purification effected on sewage (per cent.) :—		
Reduction in—		
Oxygen absorbed from permanganate	75	75
Albuminoid nitrogen	76	76
Biochemical oxygen demand	91	91

Disposal of Sludge.

Screenings, detritus, and sludge were disposed of as shown in Table 26 :—

TABLE 26.

Disposal of Screenings, Detritus, and Sludge at Withington Works.
Two Years ended 31st March, 1942.

Type of Material	Amount (tons)		Method of Disposal
	1940–41	1941–42	
Coarse material from bar screens	238	184	Removed by local farmers.
Detritus from conical tank of high level sewer	1,020	890	Discharged to lagoon and drained before removal by farmers.
Mixed detritus, sedimentation, and activated sludges	20,054	19,310	Pumped to sludge trenches.
Sludge from "Emscher" tanks	692	360	Pumped to sludge trenches.

The screenings and the detritus from the conical tank find a ready sale. A relatively small amount of sludge is lagooned and disposed of to local farmers, but the bulk of the sludge is disposed of by sludge trenching without causing nuisance.

Farming.

About 23 acres at Withington Works were farmed during the period under review and good crops were obtained of wheat, oats, hay, cabbage, swedes, etc. The income from the sale of crops produced during the years 1940–41 and 1941–42 was about £150 and £500 respectively.

Northenden Works.

A small sewage works at Northenden, formerly operated by the Bucklow Rural District Council, was taken over by the Rivers Committee on the extension of the City in 1931. The average dry weather flow is about 100,000 gallons per day. The sewage is pumped to sedimentation tanks and the tank effluent is purified in two circular percolating filters. After settlement in a humus tank the filter effluent is discharged to the River Mersey. Storm-water is settled in storm-water tanks and the effluent from the storm-water tanks receives further treatment on land. The sludge is dried on open beds and the dried sludge is sold to local farmers. The operation of the plant has been consistently satisfactory during the period under review. Results of operation are given in Table 27 :—

TABLE 27.

Average Results of Operation of Treatment Plant at Northenden Works. Two Years ended 31st March, 1942.

	1940–41			1941–42		
	Sewage	Settled Sewage	Final Effluent	Sewage	Settled Sewage	Final Effluent
Average composition (parts per 100,000) :—						
Ammoniacal nitrogen	3·48	3·48	1·19	3·98	3·38	1·28
Albuminoid nitrogen	0·80	0·47	0·12	0·95	0·57	0·12
Nitrous and nitric nitrogen	..	..	1·51	..	..	1·41
Oxygen absorbed from N/80 permanganate in four hours at 26·7°C...	6·20	3·32	0·89	6·59	3·99	0·97
Biochemical oxygen demand	..	..	1·14	..	..	1·25
Solid matter in suspension	10·80	6·50	2·70	12·10	7·00	2·20
Putrescibility on incubation for six days at 26·7°C. :—						
Number of samples—						
Putrescible	..	..	Nil	..	..	Nil
Doubtful	..	..	1	..	..	Nil
Non-putrescible	..	..	11	..	..	12
Purification effected on sewage (per cent.) :—						
Reduction in—						
Oxygen absorbed from permanganate..	..	..	85·6	..	..	85·3
Albuminoid nitrogen	..	..	85·6	..	..	87·4

Middleton Works.

The sewage works at Middleton are at present being used for the treatment of volumes of sewage in excess of four times the average dry weather flow until such times as a new connecting sewer can be constructed. The sewage reaching the works passes through sedimentation tanks. The effluent is discharged to the River Irk. The sludge from the sedimentation tanks is discharged to drying beds and about 150 tons per annum of semi-dried sludge is tipped on adjacent land and covered with soil.

RESEARCH WORK.

Filtration of Settled Sewage in a Small Experimental Enclosed Aerated Filter.

A description of this plant was given in the Annual Report for 1940.

The filter was maintained in regular operation from April to October, 1940, when bomb damage to a main sewage carrier placed it temporarily out of commission. During this period settled sewage was treated at an average rate of 4,900 gallons per day, which is equivalent to an average rate of filtration of 230 gallons per day per cubic yard of filtering material. Operation was resumed in April, 1941, and from that date until July, 1942, the filter was in regular use except for such short periods as were necessary for minor mechanical repairs. In July, 1942, alterations were made in the method of operating the contact beds and these entailed the diversion of settled sewage from the channel from which the supply to the enclosed filter had been taken. The enclosed filter was, therefore, put out of commission and the experiments brought to an end. The average volume of settled sewage treated during the latter period was 4,500 gallons a day, which is equivalent to an average rate of filtration of 210 gallons per day per cubic yard of filtering material. The results of operation during the period under review are given in Table 28 :—

TABLE 28.

Average Results of Operation of Small Experimental Enclosed Sewage Filter at Davyhulme Works.

	April—October, 1940	April, 1941—July, 1942
Average volume of settled sewage filtered per day (gallons) ..	4,900	4,500
Average rate of filtration (gallons per day per cubic yard of filtering material)	230	210
Average composition of settled effluent (parts per 100,000) :—		
Albuminoid nitrogen	0·21	0·19
Nitrous nitrogen	0·19	0·04
Nitric nitrogen	0·67	0·35
Oxygen absorbed from N/80 permanganate in four hours at 26·7°C.	2·39	2·64
Biochemical oxygen demand	1·73	2·15
Solid matter in suspension	1·8	1·8
Putrescibility on incubation for six days at 26·7°C. :—		
Number of samples—		
Putrescible	Nil	Nil
Doubtful	Nil	3
Non-putrescible	192	323
Purification effected on settled sewage (per cent.) :—		
Reduction in—		
Oxygen absorbed from permanganate..	71·4	72·3
Albuminoid nitrogen	70·7	69·0
Biochemical oxygen demand	90·6	85·8

The pressure required to force air through the filter gradually increased over a period of four months from April, 1941, from 0·1 inches to 1·6 inches (water gauge). No improvement was brought about either by increasing the flow of settled sewage to the filter or by diluting the settled sewage with final effluent in varying proportions up to fifty per cent. of the total volume. Resting the filter on alternate days for about three weeks caused a reduction in pressure to 0·55 inches and thereafter the improvement continued, the pressure varying between 0·4 and 0·2 inches.

From the results of the experiments it appears that when operating at flows in the neighbourhood of 4,500 to 5,000 gallons per day, which is somewhat less than its designed capacity, the small enclosed aerated filter cannot be relied upon to produce an entirely satisfactory effluent. The effluent was not putrescible on incubation but had a biochemical oxygen demand higher than the standard recommended as satisfactory by the Royal Commission on Sewage Disposal.

The sludge collected in the humus tank was considerably denser than that normally produced by percolating filters. The average dry solid content of the sludge was 8 per cent. and the sludge drained readily on open air draining beds. Owing to the relatively short time the plant was in operation, and the frequent unavoidable stoppages which occurred, it is not possible to draw definite conclusions with regard to the length of life of the filter.

Disposal of Surplus Activated Sludge.

The existing sludge disposal facilities at Davyhulme Works, *i.e.*, the sludge steamship "Shieldhall" on loan from Glasgow Corporation to replace the "Mancunium," which was lost by enemy action, the land areas, the sludge lagoons, the sludge digestion plant, and the sludge draining beds are just sufficient to deal with the sludge produced at the sewage works at the present time. When the new activated sludge plant is constructed after the end of the war there will be an additional large amount of surplus activated sludge to be disposed of and no provision has yet been made for this. While considering all other possibilities it was decided to re-examine the possibility of the treatment of surplus activated sludge for the production of organic fertiliser.

Experiments were done at Davyhulme between 1922 and 1926 and different methods were investigated for dewatering activated sludge by mechanical means, including centrifugal treatment, filter pressing, flotation, and vacuum filtration. Plant scale experiments were made with an early type of rotary vacuum filter. The conclusions arrived at from these early experiments were as follows :—

(1) Successful dewatering of activated sludge depends on the character and condition of the sludge.

(2) Sludge of a character and condition suitable for dewatering by vacuum filtration can be obtained by the treatment of raw sewage by the activated sludge process in order to obtain a clarified rather than a nitrified effluent or preferably by the treatment of settled sewage by the activated sludge process to the stage of advanced nitrification.

(3) The dewatering of suitable types of surplus activated sludge by chemical conditioning and vacuum filtration would be a practical proposition, assuming a market were available for the finished product at a price warranted by its value as a fertiliser.

Since the above-mentioned experiments were done a very considerable amount of work has been done, particularly in the United States, in connection with the dewatering of sewage sludge by vacuum filtration, and considerable improvements have been made in the design of vacuum filtration plant. Vacuum filtration is now a well-established process for the dewatering of sludge prior to drying and incineration or preparation for use as fertiliser or disposal by other means.

The value of activated sludge as a fertiliser has been proved by experiments carried out at Rothamsted Experimental Station and elsewhere, and there is no doubt that if activated sludge could be turned into a marketable fertiliser by an economic process this would provide the most desirable method of disposal and would be in the national interest.

Therefore, in September, 1941, a start was made on preliminary laboratory work in preparation for possible semi-scale experiments. The preliminary results were very encouraging, and in February, 1942, the Rivers Committee approved the installation of a complete semi-scale vacuum filtration plant of modern design, in order that a practical investigation might be made of the economics of the process. A thorough investigation is being made of different methods of coagulating sludge before vacuum filtration and the conditions for successful vacuum filtration are being worked out. One or two new factors have been discovered. It is hoped to publish results of the laboratory experiments in the next Annual Report.

Appendix No. II.

TABLE I. COST STATISTICS.

Rivers and Streams.

	1940–1941						1941–1942					
	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.
Surveillance of Rivers and Streams . .				398	7	11				439	12	5
Westhead's and Birley's Weirs :—												
Routine Operation	34	14	6				40	14	1			
Maintenance	21	5	4				1	0	11			
				55	19	10				41	15	0
Work in Rivers and Streams :—												
River Medlock	21	12	5				30	12	0			
River Irk	5	8	4				0	6	9			
Corn Brook, and Tributaries	16	5	2				22	18	1			
Gore, Platt, and Chorlton Brooks	15	5	5				18	16	10			
Nico Ditch	2	2	9				8	5	10			
Boggart Hole Brook, and Tributaries . .	6	13	0				30	12	9			
Ley and Cringle Brooks	2	11	0				2	8	10			
Wythenshawe Brooks	11	8	3				10	7	3			
Other Watercourses	12	5	10				9	10	7			
				93	12	2				133	18	11
Green Lane Depot :—												
Routine Work	49	17	9				70	1	6			
Air Raid Precautions	10	12	6				0	17	0			
				60	10	3				70	18	6
Culverting of Rivers and Streams by Owners. Supervision by City Engineer's Staff				1	17	0				. . . .		
Maintenance of River Medlock Invert				13	11	4				36	0	0
Work for Outside Parties (Cost Recoverable)				174	3	9				1,387	18	11
Precepts :—												
Rivers Mersey and Irwell Catchment Board	11,454	19	5				6,971	14	4			
Lancashire Rivers Board	1,837	17	5				1,650	0	0			
North-East Cheshire Rivers Catchment Board	309	16	3				523	0	0			
				13,602	13	1				9,144	14	4
Rents, Rates, and Taxes				38	18	10				38	17	0
				14,439	14	2				11,293	15	1
Credit :—												
Work for Outside Parties	*166*	*8*	*6*				*215*	*2*	*8*			
Rents and Privileges	*9*	*5*	*3*				*11*	*11*	*9*			
				175	*13*	*9*				*226*	*14*	*5*
				14,264	0	5				11,067	0	8
Central Administration				47	16	10				39	6	11
				£14,311	17	3				£11,106	7	7

SCREENING AND TANK TREATMENT.

	1940–1941							1941–1942			
	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.
Screening Plant :—	0	9				...					
Routine work	7	0				...					
Plant and fabric maintenance	1	9				...					
	9	6				...					
Detritus Tanks :—											
Cleaning and routine operation											
Fabric maintenance	6	2				971	6	10			
Pump maintenance											
Pump House maintenance											
	0	11				13,946	9	10			
						6,507	17	7			
						780	0	0			
Sedimentation Tanks :—											
Cleaning and routine operation						1,228	2	8			
Fabric and pump maintenance											
Mieder scraper maintenance	0	11				22,462	10	1			

Storm Water Tanks :

TABLE 2. DAVYHULME WORKS

Cost of Sewage Treatment and Sludge Disposal.

	1940–1941		1941–1942	
	£ s. d.	£ s. d.	£ s. d.	£ s. d.
SCREENING AND TANK TREATMENT.				
Screening Plant :—				
Routine work	383 5 0		361 1 8	
Plant and fabric maintenance	29 1 3	412 6 3	...	361 1 8
Detritus Tanks :—				
Cleaning and routine operation	3,187 12 7		2,513 10 5	
Fabric maintenance	25 11 10		73 15 0	
Pump maintenance	3 18 0		2 6 0	
Pump House maintenance	1 4 3	3,218 6 8	0 4 11	2,589 16 4
Sedimentation Tanks :—				
Cleaning and routine operation	456 10 6		549 9 3	
Fabric and pump maintenance	64 19 5		58 17 9	
Mieder scraper maintenance	18 10 0	539 19 11	44 2 11	652 9 11
Storm Water Tanks :—				
Cleaning and routine operation	661 4 4		574 8 7	
Fabric and pump maintenance	64 18 10	726 3 2	21 1 1	595 9 8
Grease Recovery :—				
Routine work	416 9 8		363 9 9	
Grease elevator maintenance	34 8 2	450 17 10	74 7 8	437 17 5
FILTRATION.				
Contact Bacteria Beds :—				
Primary Contact—				
Routine operation	1,797 14 1		1,751 12 11	
Medium surface maintenance	612 8 11		257 4 6	
Fabric maintenance	119 6 3	2,529 9 3	168 10 11	2,177 8 4
Secondary Contact—				
Routine operation	1,586 19 2		1,644 18 10	
Medium surface maintenance	915 0 10		1,277 1 5	
Fabric maintenance	3 19 6	2,505 19 6	0 5 0	2,922 5 3
ACTIVATED SLUDGE TREATMENT.				
Diffused Air Plant :—				
Routine operation	9,537 14 4		10,759 16 6	
Tank fabric maintenance	4 1 8		0 2 9	
Tank equipment maintenance	3 13 1		4 0 1	
Turbo-blowers maintenance	65 8 6		14 18 7	
Diffuser maintenance	...		15 4 6	
Minor plant maintenance	8 13 9		6 14 8	
Contribution to Renewals Fund for diffusers	750 0 0	10,369 11 4	750 0 0	11,550 17 1
" Simplex " Plant :—				
Routine operation	586 15 3		662 15 4	
Tank fabric maintenance	33 0 10		13 12 11	
Tank equipment maintenance	4 0 10	623 16 11	...	676 8 3
Bio-aeration Plant :—				
Routine operation	399 11 0		422 10 5	
Tank fabric maintenance	2 16 11		...	
Tank equipment maintenance	2 14 4	405 2 3	11 11 7	434 2 0
SLUDGE TREATMENT AND DISPOSAL.				
Sludge Ejectors :—				
Routine operation	591 12 3		699 6 3	
Mechanical plant maintenance	33 5 9		36 0 9	
Fabric and mains maintenance	7 2 5	632 0 5	8 15 11	744 2 11
Sludge Draining Beds :—				
Routine operation	....			13 2 8
Activated Sludge Well :—				
Routine work	633 1 9		671 18 9	
Thickener unit maintenance	...		...	
Pump maintenance	33 17 6		2 8 5	
Well fabric maintenance	0 8 7		...	
Pump house maintenance	0 9 1		0 5 8	
Sludge main maintenance	0 18 11	668 15 10	1 16 2	676 9 0
Sludge Storage Tanks :—				
Cleaning and routine operation	103 13 3		112 7 7	
Tank fabric maintenance	19 17 9		6 1 3	
Supernatant water straining filters: operation and maintenance	88 7 5	211 18 5	64 9 2	182 18 0
Sludge Disposal on Land (including Land Cultivation) :—				
Broadcasting sludge, ploughing, and cultivating	2,510 17 3		2,537 1 6	
Engine and pump operation	366 17 3		486 1 11	
Engine and pump maintenance	51 8 10		37 8 9	
Pump house maintenance	3 4 4		...	
Sludge main and distribution pipe maintenance	22 11 8		63 17 7	
Lagoon inspection and maintenance	...		179 2 10	
Agricultural building maintenance	...	2,954 19 4	0 9 6	3,304 2 1
Sludge Disposal at Sea :—				
s.s. " Mancunium "—				
Routine operation	9,257 0 9		...	
Canal tolls, insurances, and licences	2,576 7 0		...	
Owners' repairs and renewals, etc.	1,021 1 9		...	
	12,854 9 6		...	
Expenses—Loss of s.s. " Mancunium " and charter of s.s. " Shieldhall "	2,112 6 2		971 6 10	
s.s. " Shieldhall "—				
Routine operation	170 0 11		13,946 9 10	
Canal tolls, insurances, and licences	..		6,507 17 7	
Hire charges	..		780 0 0	
Charterer's repairs and renewals, etc.	..		1,228 2 8	
	170 0 11		22,462 10 1	
s.s. " Salford City "—				
Hire charges (Salford Corporation)	2,805 0 0		358 18 9	
Loading sludge	2 5 0		...	
	2,807 5 0		358 18 9	
Jetty and loading gear maintenance	41 2 0	17,985 3 7	26 1 10	23,818 17 6
Sludge Digestion Plant :—				
Routine operation	1,571 8 4		1,473 10 3	
Primary tanks: fabric maintenance	5 9 1		2 1 9	
Secondary tanks: fabric maintenance	0 5 5		4 18 11	
Pumps, heating, and stirring mechanism: maintenance	45 17 6		183 13 11	
Boiler maintenance	13 9 7		371 10 8	
Building maintenance	9 17 9	1,646 7 8	...	2,035 15 6
Sludge Pressing :—				
Plant and building maintenance	..	7 17 6	...	3 12 7
ANCILLARY WORK.				
Gauging and Sampling Sewage :—				
Routine work	167 13 2		174 8 4	
Recording apparatus maintenance	48 14 9	216 7 11	28 4 6	202 12 10
Sewage and Effluent Channels :—				
Routine cleaning	55 9 0		9 14 7	
Fabric maintenance	57 5 5	112 14 5	42 12 3	52 6 10
Laboratories :—				
Routine work	2,244 7 6		2,431 19 10	
Building maintenance	4 12 9	2,249 0 3	2 7 5	2,434 7 3
Roads, Ditches, and Watercourses :—				
Davyhulme Works	87 0 1		132 15 5	
Flixton Estate	16 18 3		27 17 10	
Carrington Estate	40 3 3	144 1 7	40 18 9	201 12 0
Fencing :—				
Davyhulme Works	65 18 7		72 6 0	
Flixton Estate	...		0 16 3	
Carrington Estate	...		0 8 5	
Land along line of main outfall sewer	1 8 11	67 7 6	0 19 1	74 9 9
Gardening		225 12 4		169 10 8
Weed Removal and Disposal		223 4 8		275 17 2
Experimental Enclosed Sewage Treatment Plant :—				
Routine operation	6 16 9		8 8 3	
Equipment maintenance	2 11 2	9 7 11	20 3 4	28 11 7
Air Raid Precautions :—				
Provision and maintenance of A.R.P. shelters and equipment	298 15 3		434 18 0	
A.R.P. operation	316 1 7	614 16 10	343 8 9	778 6 9
Work for Outside Parties (Recoverable)		283 15 3		1,285 18 9
Sundry Unclassified Items		69 3 11		49 18 0
Rents, Rates, and Taxes		10,034 2 8		10,719 4 4
Works Administration :—				
Routine work	2,427 11 2		2,468 2 11	
Administration buildings maintenance	72 19 9		5 5 5	
Manager's house maintenance	69 11 10	2,570 2 9	100 7 4	2,573 15 8
SEWAGE PUMPING.				
Davyhulme Parish Sewage :—				
Routine work	399 13 5		515 7 2	
Pump maintenance	11 10 11		80 9 8	
Fabric maintenance	6 7 4	417 11 8	0 8 1	596 4 11
		63,126 5 6		72,653 8 8
Credit :				
Sale of grease	*407 7 9*		*438 10 6*	
Sale of produce grown on land	*305 2 6*		*157 5 6*	
Sale of sundry materials	*177 6 1*		*102 6 8*	
Work for outside parties	*445 17 0*		*1,270 8 11*	
Rents of farm lands, and privileges	*144 19 1*	*1,480 12 5*	*145 9 4*	*2,114 0 11*
		61,645 13 1		70,539 7 9
Central Administration		3,584 15 8		3,959 14 11
		£65,230 8 9		£74,499 2 8

In comparing the above costs with the Revenue charge on the rates (see page 10), the following adjustments should be made :—

	£	£	£	£
Deductions.				
Payments by other Local Authorities for the treatment of sewage	28,313		33,788	
Income from treatment of trade effluent	373	28,686	1,662	35,450
Additions.				
War Service Allowances	812		1,241	
Construction of Sludge Lagoons at Flixton	5,694		4,505	
Preliminary work on Activated Sludge Units	63		...	
Construction of Sludge Draining Beds	...	6,569	7,762	13,508
Total Deduction		£22,117		£21,942

TABLE 3. WITHINGTON WORKS

Cost of Sewage Treatment and Sludge Disposa

SCREENING AND TANK TREATMENT.	1940–1941 £	s.	d.	£	s.	d.
Screens and Catchpits :—						
Routine work	120	12	3			
Screen and catchpit maintenance	4	16	0			
				125	8	3
Settlement Tanks :—						
Routine work	126	2	11			
Tank fabric maintenance	3	5	10			
				129	8	9
Grease Recovery				16	8	9
FILTRATION.						
Contact Bacteria Beds :—						
Routine operation	359	14	5			
Medium surface maintenance	159	3	1			
Fabric maintenance	...					
				518	17	6
ACTIVATED SLUDGE TREATMENT.						
Diffused Air Plant :—						
No. 1 Unit—						
Routine operation	87	6	1			
Tank fabric maintenance	2	14	0			
Air pipe and valve maintenance	1	15	8			
Diffuser maintenance	1	2	9			
No. 2 Unit—						
Routine operation	125	1	5			
Tank fabric maintenance	29	1	11			
Air pipe and valve maintenance	0	11	1			
Diffuser maintenance	142	15	5			
Power charges	1,156	16	11			
Air compressing plant maintenance	17	6	8			
Minor plant maintenance	6	4	2			
Experimental work	51	3	6			
				1,621	19	7
SLUDGE DISPOSAL.						
On Land :—						
Digging, filling, and covering grips and lagoons	424	2	1			
Sludge main and pipe maintenance	1	2	8			
Plant maintenance	24	19	5			
Sludge tank fabric maintenance	...					
Press house maintenance	7	2	9			
Cleaning surface of contact beds used for filtering effluent from activated sludge plant	208	17	10			
Power charges	135	11	3			
Land cultivation	379	4	2			
				1,181	0	2

TABLE 3. WITHINGTON WORKS

Cost of Sewage Treatment and Sludge Disposal.

	1940–1941		1941–1942	
	£ s. d.	£ s. d.	£ s. d.	£ s. d.
SCREENING AND TANK TREATMENT.				
Screens and Catchpits :—				
Routine work	120 12 3		141 3 11	
Screen and catchpit maintenance	4 16 0		19 12 10	
		125 8 3		160 16 9
Settlement Tanks :—				
Routine work	126 2 11		137 5 0	
Tank fabric maintenance	3 5 10		2 19 9	
		129 8 9		140 4 9
Grease Recovery		16 8 9		16 18 11
FILTRATION.				
Contact Bacteria Beds :—				
Routine operation	359 14 5		384 6 1	
Medium surface maintenance	159 3 1		87 2 0	
Fabric maintenance	...		...	
		518 17 6		471 8 1
ACTIVATED SLUDGE TREATMENT.				
Diffused Air Plant :—				
No. 1 Unit—				
Routine operation	87 6 1		97 19 9	
Tank fabric maintenance	2 14 0		0 6 8	
Air pipe and valve maintenance	1 15 8		7 1 1	
Diffuser maintenance	1 2 9		...	
No. 2 Unit—				
Routine operation	125 1 5		146 16 8	
Tank fabric maintenance	29 1 11		...	
Air pipe and valve maintenance	0 11 1		2 9 10	
Diffuser maintenance	142 15 5		11 2 9	
Power charges	1,156 16 11		1,279 10 11	
Air compressing plant maintenance	17 6 8		6 9 5	
Minor plant maintenance	6 4 2		...	
Experimental work	51 3 6		52 17 8	
		1,621 19 7		1,604 14 9
SLUDGE DISPOSAL.				
On Land :—				
Digging, filling, and covering grips and lagoons	424 2 1		361 14 0	
Sludge main and pipe maintenance	1 2 8		1 6 9	
Plant maintenance	24 19 5		...	
Sludge tank fabric maintenance	...		...	
Press house maintenance	7 2 9		...	
Cleaning surface of contact beds used for filtering effluent from activated sludge plant	208 17 10		186 5 6	
Power charges	135 11 3		144 4 6	
Land cultivation	379 4 2		571 15 8	
		1,181 0 2		1,265 6 5
ANCILLARY WORK.				
Sewage and Effluent Channels		18 13 7		154 16 8
Laboratory		222 1 4		225 13 1
Gardening		6 11 4		9 6 1
Fencing		10 2 11		10 3 9
Roads, Ditches, and Watercourses		40 4 10		50 0 5
Weed Removal and Disposal		28 2 0		32 6 4
Cottages, Maintenance		5 17 11		1 15 8
Air Raid Precautions		51 18 2		82 13 0
Miscellaneous		26 19 6		25 17 4
Rents, Rates, and Taxes		1,318 15 3		1,380 12 10
Works Administration		453 19 4		526 4 9
SEWAGE PUMPING.				
Power charges	914 8 9		808 3 9	
Pump maintenance	97 3 5		8 14 5	
		1,011 12 2		816 18 2
		6,788 1 4		6,975 17 9
Credit :—				
Sale of grease	*16 7 5*		*9 16 6*	
Sale of produce grown on land	*171 0 6*		*563 14 8*	
Sale of redundant plant, etc.	*117 10 0*		...	
Miscellaneous sales	*20 16 11*		*13 16 0*	
Rents of cottages and land	*97 16 6*		*101 13 8*	
		423 11 4		*689 0 10*
		6,364 10 0		6,286 16 11
Central Administration		398 14 3		378 10 1
		£6,763 4 3		£6,665 7 0

In comparing the above costs with the Revenue charge on the rates (see page 10), the following adjustments should be made :—

	£	£
Deduction.		
Transfer from Bacteria Beds Renewal Account	1,057	...
Additions.		
War Service Allowances	68	173
Total Deduction	989	
Total Addition		173

TABLE 4. MINOR WORKS.

(*a*) NORTHENDEN WORKS.

	1940–1941		1941–1942	
	£ s. d.	£ s. d.	£ s. d.	£ s. d.
SEWAGE TREATMENT PLANT :—				
Routine work	74 5 5		91 9 11	
Fabric maintenance	6 5 5		...	
		80 10 10		91 9 11
SLUDGE DISPOSAL :—				
Pumping and routine work	146 6 8		132 9 3	
Draining beds maintenance	2 17 8		5 12 9	
		149 4 4		138 2 0
PUMPING SEWAGE TO SEDIMENTATION TANKS		183 2 1		225 9 7
SEWAGE AND EFFLUENT CHANNELS		...		2 7 10
LAND CULTIVATION		130 13 2		171 2 10
GARDENING		15 12 4		15 9 4
WEED REMOVAL AND DISPOSAL		41 10 11		31 13 10
MISCELLANEOUS		27 19 2		9 7 5
AIR RAID PRECAUTIONS		8 10 2		11 12 9
RENTS, RATES, AND TAXES		121 8 9		116 8 3
WORKS ADMINISTRATION		27 12 8		28 11 8
		786 4 5		841 15 5
Credit :—				
Sale of produce grown on land	*33 17 6*		*36 7 3*	
Sundries	*1 4 5*		*0 15 8*	
Rent of land	*2 10 0*		*2 10 0*	
		37 11 11		*39 12 11*
		748 12 6		802 2 6
CENTRAL ADMINISTRATION		45 14 6		45 8 10
		£794 7 0		£847 11 4
HEYHEAD SEPTIC TANK		£11 7 5		£21 5 11

(*b*) MIDDLETON WORKS.

	1940–1941	1941–1942
ROUTINE WORK	188 9 2	188 11 6
GENERAL CLEANING AND SUNDRIES	23 17 11	41 15 11
RENTS, RATES, AND TAXES	43 1 5	43 1 5
WORKS ADMINISTRATION	16 15 0	15 3 9
	272 3 6	288 12 7
Credit :—		
Rent of Building	*20 0 0*	*20 0 0*
	252 3 6	268 12 7
CENTRAL ADMINISTRATION	15 16 7	15 11 7
	£268 0 1	£284 4 2

(*c*) MOSS SIDE WORKS

(DISUSED).

	1940–1941	1941–1942
BUILDINGS AND PLANT MAINTENANCE	52 8 1	63 4 2
MISCELLANEOUS	37 7 3	5 12 11
RENTS, RATES, AND TAXES	26 2 0	8 19 6
	115 17 4	77 16 7
Credit :—		
Rent of houses, privileges, and Sundries	*79 16 10*	*72 2 8*
	36 0 6	5 13 11
CENTRAL ADMINISTRATION	6 14 9	4 4 0
	£42 15 3	£9 17 11

(*d*) GORTON SEWAGE WORKS

(DISUSED).

	1940–1941		1941–1942	
RENTS, RATES, AND TAXES		176 8 7		329 13 11
Credit :—				
Transfer of land		*345 13 3*		*345 13 3*
	Credit	*£169 4 8*	*Credit*	*£15 19 4*

TABLE 5. UNIT COSTS.

(*a*) DAVYHULME WORKS.

	1940—1941			1941—1942		
	Revenue	Capital	Total	Revenue	Capital	Total
SEWAGE TREATMENT AND SLUDGE DISPOSAL :—						
Cost per million gallons dry weather flow	£4 8 3·0	£3 14 2·8	£8 2 5·8	£5 0 9·5	£4 5 8·5	£9 6 6·0
Cost per million gallons treated	£3 0 8·3	£2 11 0·6	£5 11 8·9	£3 12 3·8	£3 1 5·9	£6 13 9·7
Cost per million gallons treated (excluding cost of pumping sewage)	£3 0 3·6	£2 11 0·6	£5 11 4·2	£3 11 8·8	£3 1 5·9	£6 13 2·7
Cost per head of population connected to works	0 1 8·3	0 1 5·1	0 3 1·4	0 2 0·5	0 1 8·8	0 3 9·3

	1940–1941	1941–1942
SLUDGE DISPOSAL :—		
At Sea—		
Cost per steamship trip	£86 14 8·9	£211 11 0·3
Cost per ton of sludge	0 1 8·0	0 3 1·6
On Land—		
Cost per ton of sludge	0 0 4·4	0 0 3·0
SLUDGE DIGESTION :—		
Cost per ton of sludge treated	0 0 4·0	0 0 6·2
SLUDGE TREATMENT AND DISPOSAL BY ALL METHODS (EXCLUDING DETRITUS) :—		
Average cost per ton of sludge disposed of	0 1 4·5	0 1 5·8
RAIL TRANSPORT :—		
Cost per locomotive and wagons per operative hour (excluding driver)	0 5 9·5	0 4 6·9
MOTOR TRANSPORT :—		
Cost per operative hour (excluding driver)	0 2 3·5	0 3 3·7
Cost per mile run (excluding driver)	0 0 4·7	0 0 7·2
DIESEL EXCAVATOR (½ CUBIC YARD) :—		
Cost per operative hour (excluding operator)	0 2 9·0	0 6 9·4
GRAB CRANE (DETRITUS TANKS) :—		
Cost per operative hour (excluding operator)	0 2 7·8	0 2 8·5
"SIMAR" ROTOTILLERS :—		
Cost per operative hour (excluding operator)	0 4 2·4	....
TRACTORS :—		
Cost per operative hour (excluding operator)	0 2 10·6	0 4 10·8
WORKSHOP EXPENSES (ONCOST PER JOB HOUR) :—		
General Fitting Shops	0 0 2·1	0 0 2·4
Blacksmiths' Shop	0 0 8·6	0 0 11·6
Joiner's Shop	0 0 1·6	0 0 2·2
Painter's Shop	0 0 1·6	....

(*b*) WITHINGTON WORKS.

	1940—1941			1941—1942		
	Revenue	Capital	Total	Revenue	Capital	Total
SEWAGE TREATMENT AND SLUDGE DISPOSAL :—						
Cost per million gallons dry weather flow	£11 11 7·4	£0 1 7·7	£11 13 3·1	£11 8 3·2	£0 2 2·3	£11 10 5·5
Cost per million gallons treated	£9 7 11·2	0 1 4·0	£9 9 3·2	£9 5 7·7	0 1 9·4	£9 7 5·1
Cost per million gallons treated (excluding cost of pumping sewage)	£7 19 9·9	0 1 4·0	£8 1 1·9	£8 2 10·7	0 1 9·4	£8 4 8·1
Cost per head of population connected to works	0 2 10·5	0 0 0·2	0 2 10·7	0 2 10·0	0 0 0·3	0 2 10·3

	1940—1941	1941—1942
SLUDGE DISPOSAL :—		
Cost per ton of sludge dealt with	£0 1 1·0	£0 1 2·8

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